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NETGEAR™

Fast Ethernet Switch with Gigabit Uplinks

Installation Guide

MODEL FS518T

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Cet appareil numérique (Model FS518T Fast Ethernet Switch) respecte les limites de bruits radioélectriques visant les appareils numériques de classe A prescrites dans le Règlement sur le brouillage radioélectrique du ministère des Communications du Canada.

Customer Support

For assistance with installing and configuring your NETGEAR system or with questions or problems following installation:

- Check the NETGEAR Web page at http://www.NETGEAR.com.
- Call Technical Support at the phone number listed on the Support Information Card that shipped with your switch.
- Email Technical Support at support@NETGEAR.com.

Defective or damaged merchandise can be returned to your point-of-purchase representative.

Internet/World Wide Web

NETGEAR maintains a World Wide Web home page that you can access at the universal resource locator (URL) http://www.NETGEAR.com. A connection to the Internet and a Web browser such as Internet Explorer or Netscape are required.

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CHAPTER 1: INTRODUCTION

Congratulations on your purchase of the NETGEAR Model FS518T Fast Ethernet Switch. This switch provides you with a low-cost, high-performance network solution and is designed to support power workgroups operating at either 10 megabits per second (Mbps) or 100 Mbps.

To relieve server and backbone bottlenecks, the Model FS518T switch also has two Gigabit Ethernet RJ-45 uplink ports.

Benefits of Using Switching Technology

A majority of installed networks today are based on shared network technology. With this technology, a number of users or groups of users share a total available network bandwidth (or network capacity) of 10 Mbps, 100 Mbps, or other amounts of network bandwidth. For example, with a total of 10 users, the average bandwidth available to each user on a 10 Mbps network is calculated as 10/10 Mbps, which equals 1 Mbps of bandwidth per user. On a 100 Mbps (Fast Ethernet) network, the average bandwidth available to each of the 10 users is 100/10 Mbps, which equals 10 Mbps of bandwidth per user.

Ethernet switches significantly increase network throughput by segmenting network traffic. They check traffic coming in to each port to learn which network device is located on which segment. Based on this information, switches forward cross-segment traffic only to the appropriate segment. The traffic will not show up in the other segments because it is filtered out. In this way, network capacity is fully reserved for traffic destined for that segment only, and other segments will not be saturated with unnecessary traffic.

Ethernet switches provide private, dedicated, 10 Mbps (or 100 Mbps) capacity to each connected PC/server or hub/workgroup segment, which is significantly higher than in a shared environment. The higher bandwidth enables the use of applications such as multimedia, imaging, video, or high-performance client-server functions among users who are spread out over the network.

This improvement is accomplished very easily, with no change to the desktop (the network interface cards or software and the network wiring). As a result, the performance upgrade and the applications it enables are obtained very quickly and at a low cost.

When all network ports are operating at 100 Mbps and sending traffic to the server, the server needs a faster transmission speed to avoid bottlenecks. The 1000 Mbps (Gigabit) ports add the necessary increase in throughput.

Types of Ethernet Switches

Ethernet switches can be classified in different ways—as desktop switches or as segment switches. A desktop switch is designed to support one or a few PCs per port. It is generally used when the individuals need the full 10 Mbps network throughput to support the applications. Often, these switches support only a single MAC (media access control) address per port, have high-speed 100 Mbps ports to connect to fast servers, and are relatively inexpensive compared to a segment switch. A segment switch, in contrast, is designed to support an entire workgroup on each port, with each port having significant memory buffering and supporting thousands of MAC addresses.

Switches can also be classified by speed. As the name suggests, 10 Mbps switches support only 10 Mbps connections. Similarly, 100 Mbps switches support only 100 Mbps connections. Usually, 10/100 Mbps switches have primarily 10 Mbps ports with only one or a few 100 Mbps ports. Auto-sensing 10/100 Mbps switches support 10 Mbps or 100 Mbps connections on each port and are the most versatile and adaptive type of switches. Gigabit (1000 Mbps) switch ports are used to connect to shared network resources and network backbones at higher speed.

Model FS518T Switch Overview

The NETGEAR Model FS518T Fast Ethernet Switch with Gigabit uplinks is an auto-sensing 10/100 Mbps switch with two 100/1000 Gigabit uplink interfaces. This high-performance switch is developed primarily to be used either as a segment switch or a desktop switch.

The Gigabit Ethernet uplink ports on the Model FS518T switch can be used to connect to the network backbone and shared network resources, such as servers, at 10 Mbps, 100 Mbps, or 1000 Mbps. The full-duplex 1000BASE-T ports allow users to connect at high speed to a wiring closet or server located up to 100 meters away, on existing Category 5 unshielded twisted pair (UTP) cable.

All of the network ports on the Model FS518T switch can adapt automatically to the speed of the connected network or the PC, and the ports can operate at either 10 Mbps or 100 Mbps. In addition, each port can automatically negotiate with the connected device to operate in full-duplex mode. If the connected device is operating in half-duplex mode only, or does not have the capability to participate in the negotiation process, the port will default to half-duplex mode.

The Model FS518T switch can be used to partition a 10 Mbps or 100 Mbps network to enhance the capacity of the network to support advanced applications. In addition, the switch provides a link between traditional 10 Mbps networks and faster 100 Mbps networks. By installing a Model FS518T switch, a user can connect any 10 Mbps or 100 Mbps device to the switch. The Model FS518T switch provides a built-in upgrade path; you can remove a 10 Mbps connection and replace the connection with a 100 Mbps connection with little or no change to the rest of the network.

The Model FS518T switch can be effectively used to join multiple 100 Mbps Fast Ethernet segments and to extend the reach of the network. Copper-based Fast Ethernet networks have a network diameter of up to 200 meters. The Model FS518T switch can be used to join these 200-meter segments to enable them to function as a single logical network. With one Model FS518T switch, the reach extends to 400 meters.

All 10/100 ports can auto negotiate the duplex mode with the connected device. If the other link partner does not support negotiation, the ports default to half-duplex

mode. Gigabit ports will advertise their speed and full-duplex operation, and negotiate flow control with the connected device at 1000BASE-T and 100BASE-TX.

Because the Model FS518T switch is an ISO media access control (MAC) layer device, the switch is network protocol independent and compatible with all popular networks such as the Internet or TCP/IP, NetWare, DECnet, Microsoft NETBEUI, and LANTASTIC.

Features

The Model FS518T switch has the following key features:

- Sixteen auto-negotiating (speed, duplex mode, and flow control) 10/100 Mbps UTP ports to provide fast information exchange, resource sharing, and client or peer-to-peer communication using simple Category 5 UTP cable
- Eighteen vista RJ-45 network ports, with built-in LEDs to monitor individual port status
- Two auto-negotiating (speed, duplex mode, and flow control) 100/1000 Mbps UTP ports which support 100 Mbps or 1000 Mbps full-duplex with standard RJ-45 connectors
- Auto negotiation supported by all 10/100 Mbps and Gigabit ports
- Automatic address-learning function to build the packet-forwarding information table

  The table contains up to 8,000 MAC addresses (that is, the switch can support networks with as many as 8,000 devices).
- Wire-speed filtering and forwarding to direct traffic to the appropriate route without slowing down the traffic
- Store-and-forward forwarding mode to minimize erroneous packets on the network
- Aging function to automatically track changes in network configuration

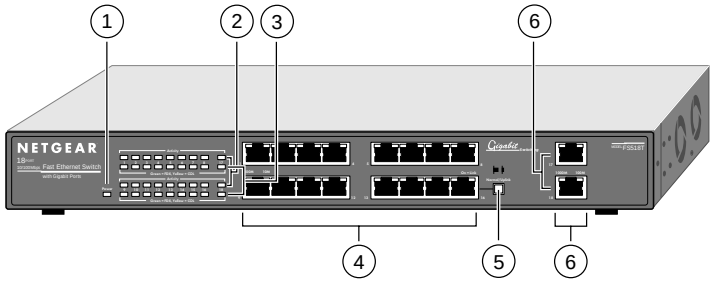
- Minimum latency of packet transmission (leading edge to leading edge) less than 80 µs
- Easy Plug and Play installation with no software to configure, saving time and minimizing the potential for configuration errors
- Protocol independence and compatibility with all common protocols, such as TCP/IP, NetWare, DECnet, and Microsoft Networks
- Normal/Uplink push button to simplify network extension to 10/100 segments
- Connection to a hub, using a simple, straight-through cable
- Auto MDI/MDIX on Gigabit ports, requiring no Normal/Uplink switch on the two Gigabit ports
- Conformity to standards:
  - IEEE 802.3 10BASE-T standard
  - IEEE 802.3u 100BASE-TX standard
  - IEEE 802.3ab 1000BASE-T standard
  - IEEE 802.3x flow control
- Rack Mount Kit provided for installing the switch in a standard 19-inch equipment rack, or for mounting on the wall

CHAPTER 2: PHYSICAL DESCRIPTION

This chapter describes the hardware features of the NETGEAR Model FS518T Fast Ethernet Switch.

Front Panel

For easier management and control of the Model FS518T switch, familiarize yourself with the ports, LEDs, and Normal/Uplink push button on the front panel of the switch, as illustrated in Figure 2-1.



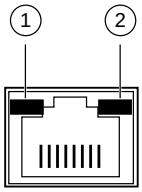
Key:
1 = Power LED
2 = Rx/Tx LEDs
3 = FDX/COL LEDs
4 = 10/100 Mbps UTP ports with 10M or 100M Link LEDs on each port
5 = Normal/Uplink push button for port 16
6 = 100/1000 Mbps UTP ports with 100M or 1000M link LEDs on each port

Figure 2-1. Front Panel of the Model FS518T Switch

As Figure 2-1 shows, the Model FS518T switch is equipped with 16 auto-sensing 10/100 Mbps Fast Ethernet UTP ports. The network access speed for the 10/100 Mbps ports is automatically sensed and displayed on the front panel by the 10 Mbps or 100 Mbps Link LEDs.

The 10/100 Mbps ports support only UTP cable using an 8-pin RJ-45 plug. Each of the 10/100 Mbps ports uses vista RJ-45 connectors that have built-in LEDs, as illustrated in Figure 2-2. The LEDs, as described in Table 2-1 on page 2-5, indicate that the connection to the port is valid and that the port is operating at either 10 or 100 Mbps.

For further information about the vista RJ-45 connector and the RJ-45 plug, refer to Appendix B, "Connector Pin Assignments," and Appendix C, "Cabling Guidelines."

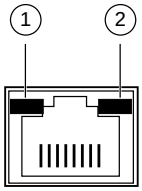


Key:
1 = 100M Link LED
2 = 10M Link LED

Figure 2-2. Vista RJ-45 Connector with Built-in LEDs

1000BASE-T UTP Ports

The Model FS518T switch has two 1000BASE-T UTP ports. These ports can operate at 1000 Mbps full-duplex mode or 100 Mbps full/half duplex mode, and provide a standard UTP for Category 5 or Category 5e cable. Figure 2-3 shows a vista RJ-45 connector. For further information about Category 5 cables and connectors, refer to Appendix B, "Connector Pin Assignments," and Appendix C, "Cabling Guidelines." The 1000BASE-T requires very careful cable installation.



Key:
1 = 1000M Link LED
2 = 100M Link LED

Figure 2-3. 1000BASE-T Vista RJ-45 Connector with Built-in LEDs

Normal/Uplink Push Button

The Normal/Uplink push button on the front panel of the switch, as illustrated in Figure 2-1, allows you to select uplink (MDI) or normal (MDI-X) wiring for port 16 on the Model FS518T switch. This port is configured for normal wiring to connect to a PC when the push button is in the out position. When the push button is pressed in, this port is configured for uplink wiring to connect to another switch or to a hub, using a straight-through twisted pair cable.

Auto MDI/MDIX

The 1000BASE-T ports will automatically detect a crossover cable and correct for cabling cross overs.

LEDs

The LEDs on the front panel of the switch and two vista LEDs on each RJ-45 connector allow you to identify the following information:

- Status of the power supply
- For each 10/100 Ethernet port:
  - Network link at 10 Mbps or 100 Mbps
  - Data transmission or receive activity
  - Collision occurrence when in half-duplex mode or full-duplex mode
- For the 100/1000 Gigabit Ethernet port:
  - Network link of 100 Mbps or 1000 Mbps
  - Data transmission or receive activity at 100 Mbps or 1000 Mbps
  - Collision occurrence when in half-duplex mode or full-duplex mode at 100 Mbps or 1000 Mbps

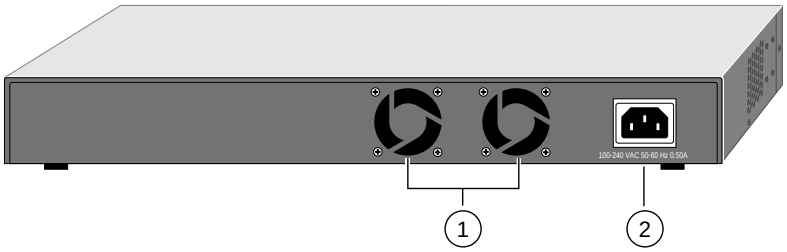
Table 2- 1 describes each LED on the front panel of the Model FS518T switch.

Table 2-1. LED Descriptions

Label	Color	Activity	Description
Power	Green	On	Power is supplied to the switch.
		Off	Power is disconnected.
Rx/Tx	Green	Blinking	Packet transmission or reception is occurring on the port. The blinking action corresponds to the number of packets that are transmitted or received.
		Off	No packet transmission or reception is occurring on the port.
FDX/COL	Green	On	A full-duplex link is established on the port.
	Yellow	On	A half-duplex link is established on the port, and the port is experiencing collisions. (Note that occasional collisions are normal.)
		Off	No full-duplex link is established, or no collisions are occurring on the port when operating in half-duplex mode.
100M Link (located at the top left corner each 10/100 Mbps UTP port)	Green	On	A valid 100 Mbps link is established on the port.
		Off	No 100 Mbps link is established on the port.
10M Link (located at the top right corner of each 10/100 Mbps UTP port)	Green	On	A valid 10 Mbps link is established on the port.
		Off	No 10 Mbps link is established on the port.
1000M Link (located at the top left corner of each 100/1000 Mbps UTP port)	Green	On	A valid 1000 Mbps link is established on the port.
		Off	No 1000 Mbps link is established on the port.
100M Link (located at the top right corner of each 100/1000 Mbps UTP port)	Green	On	A valid 100 Mbps link is established on the port.
		Off	No 100 Mbps link is established on the port.

Rear Panel

As illustrated in Figure 2-4, the rear panel of the Model FS518T switch has a cooling fan and a standard AC power receptacle.



Key:
1= Cooling fans
2= AC power outlet

Figure 2-4. Rear Panel of the Model FS518T Switch

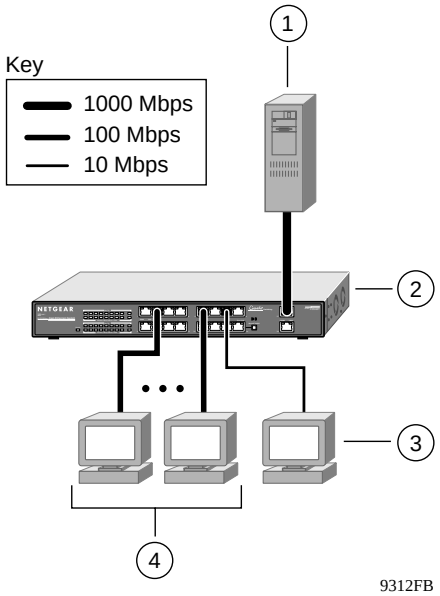
CHAPTER 3: APPLICATIONS

This chapter presents an overview of the levels of service provided by incorporating the technology of the Model FS518T Fast Ethernet Switch into your network.

The Model FS518T switch is designed to provide flexibility in configuring your network connections. Each switch can be used as a stand-alone device or can be used with 10 Mbps, 100 Mbps, or 1000 Mbps hubs or other interconnection devices in various configurations. The configuration examples in this chapter illustrate the integration of the NETGEAR Model FS518T Fast Ethernet Switch with Gigabit uplinks in network environments of all sizes and types. These examples include a network of a few workstations connected to a printer or a segmented network with multiple users or workgroups and other networking devices.

Desktop Switching

Figure 3-1 illustrates the Model FS518T switch, used as a desktop switch to build a small network that enables users to have Gigabit (1000 Mbps) access to a file server.



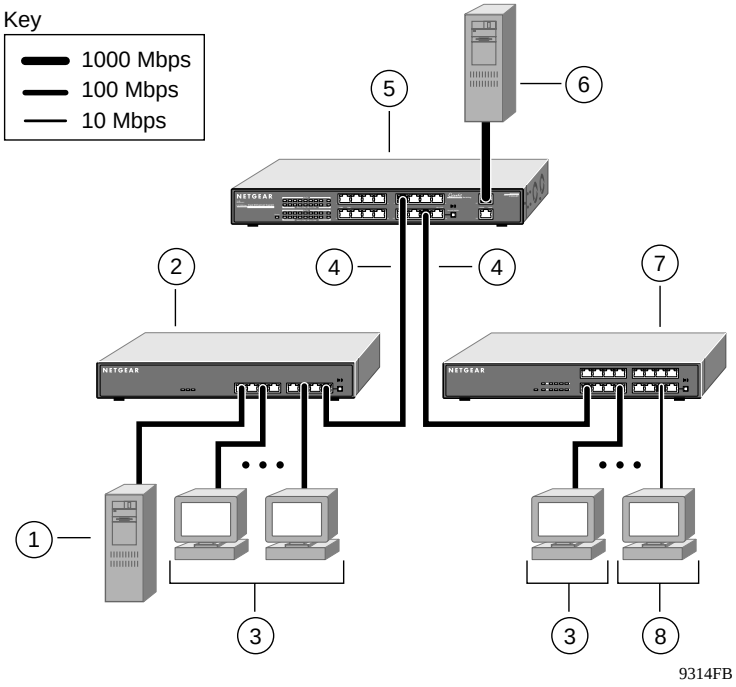
Key:
1 = Server with 2000 Mbps connection (1000 Mbps full-duplex)
2 = Model FS518T Fast Ethernet Switch (Normal/Uplink push button set to Normal position)
3 = PC with 10 Mbps connection
4 = PCs with 100 Mbps Fast Ethernet adapter cards installed

Figure 3-1. Model FS518T Switch Used as a Desktop Switch

Note: If a full-duplex adapter card is installed in the server or PC, a 2000 Mbps connection is possible on the port where the server is connected.

Segment Switching

The Model FS518T switch can segment a network into multiple connected pieces, increasing overall bandwidth and throughput. Figure 3-2 illustrates the Model FS518T switch segmenting networks that are built with a NETGEAR Model FE508 Fast Ethernet Hub and a NETGEAR Model DS516 Dual Speed Hub.



Key:
1 = Server with 100 Mbps connection
2 = Model FE508 Fast Ethernet Hub (Normal/Uplink push button set to Uplink position)
3 = PCs with network adapter installed, enabling 100 Mbps connection
4 = 100 Mbps connection
5 = Model FS518T Fast Ethernet Switch (Normal/Uplink push button set to Uplink position)
6 = Server with 2000 Mbps connection (1000 Mbps full-duplex)
7 = Model DS516 Dual Speed Hub (Normal/Uplink push button set to Uplink position)
8 = PC connected at 10 Mbps

Figure 3-2. Model FS518T Switch Used as a Segment Switch

CHAPTER 4: INSTALLATION

This chapter describes the installation procedures for the Model FS518T Fast Ethernet Switch.

Preparing the Site

Before you begin installing the switch, prepare the installation site. Make sure the operating environment meets the physical requirements of the switch, as described in Appendix A, "Technical Specifications."

Checking Package Contents

Unpack the contents of the package and verify them against the following list:

- NETGEAR Model FS518T Fast Ethernet Switch
- Self-adhesive rubber footpads for desktop installation
- Rack Mount Kit for rack installation
- AC power cord
- Warranty & Owner Registration Card
- This installation guide
- Support Information Card

Caution: Use the appropriate power cord as required by your national electrical codes and ordinances.

Call your reseller or customer support in your area if there are any wrong, missing, or damaged parts. Refer to the enclosed Customer Support Information Card for more information.

Keep the carton, including the original packing materials. Use them to repack the switch if you need to return it for repair.

To qualify for product updates and product warranty registration, fill in the Warranty & Owner Registration Card within 30 days of purchase and return it to NETGEAR, Inc.

Installing a Switch

To install a switch on a desktop, on another flat surface, or in a rack:

1. Unpack the switch.
2. Choose a location near the devices to be connected and close to an electrical outlet.
3. Proceed to "Installing the Switch on a Flat Surface" or "Installing the Switch in a Rack."

Installing the Switch on a Flat Surface

To install the switch on a desktop or any other flat surface:

1. Install self-adhesive rubber footpads on the bottom of the switch.

   Peel off the protective backing from the rubber pads and apply one at each marked location on the bottom of the switch.

2. Set the switch on a desktop or any other flat surface.

   For proper ventilation, make sure that the switch has at least 2 inches of space on each side and 5 inches of space at the back. It is very important that the fans located in the rear panel are not blocked.

Caution: Restricted airflow could cause overheating of the components.

Installing the Switch in a Rack

To mount the switch in a standard 19-inch equipment rack, you need these tools and materials:

- Two mounting brackets supplied from the Rack Mount Kit
- Eight screws supplied from the Rack Mount Kit to attach the mounting brackets to the switch
- Four screws and nylon washers supplied from the Rack Mount Kit to attach the mounting brackets to the rack
- #1 Phillips screwdriver
- #2 Phillips screwdriver

To install the switch in a rack:

1. Attach the mounting brackets to the sides of the switch as illustrated in Figure 4-1.

   Hold a mounting bracket against each side of the switch and align the countersunk screw holes in the bracket with the bracket mounting holes in the switch.

2. Insert the screws provided in the Rack Mount Kit through each bracket and into the bracket mounting holes in the switch.

3. Using a #1 Phillips screwdriver, tighten the screws to secure each bracket.

4. Hold the switch with the mounting holes in the brackets aligned with the holes in the rack.

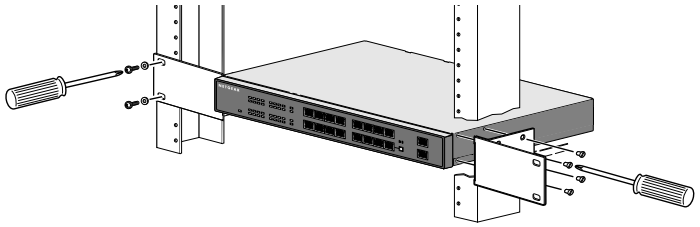


Figure 4-1. Attaching Mounting Brackets to the Model FS518T Switch

5. Insert two pan-head screws with nylon washers through each bracket and into the rack.

6. Using a #2 Phillips screwdriver, tighten the screws to secure the switch to the rack.

   For proper ventilation, make sure that the switch has at least 2 inches of space on each side and 5 inches of space at the back. It is very important that the fans located in the rear panel are not blocked.

Caution: Restricted airflow could cause overheating of the components.

To connect additional switches or other devices, refer to "Connecting Devices to the Switch."

Connecting Devices to the Switch

To connect devices to the switch:

1. Connect the devices to the 10/100 Mbps ports on the switch, using Category 5 UTP cable.

⇨ **Note:** Ethernet specifications limit the cable length between your PC or server and the switch to 328 feet (100 meters) in length.

2. Connect one end of the Category 5 UTP cable to the Gigabit uplink port and the other end to the linking server or network device.

⇨ **Note:** Gigabit copper over Category 5 cable needs to meet the requirements specified in Appendix C.

3. Connect one end of the AC power cord to the power outlet on the rear panel of the switch and the other end of the AC power cord to the wall outlet.

   Refer to Figure 4-2 on page 4-6 when connecting the Model FS518T switch.

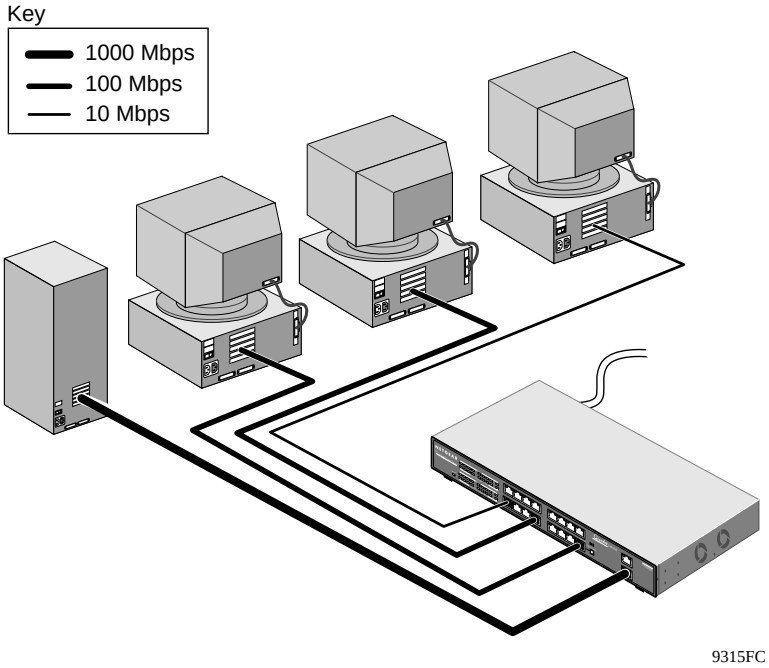


Figure 4-2. Connecting to the Model FS518T Fast Ethernet Switch

Note: The 1000 Mbps Gigabit Ethernet port always operates at full-duplex mode.

Verifying Installation

Verify network communications by ensuring that all the necessary connections have been made, that all connected resources can be accessed, and that the LED indicators on the switch are functioning properly. For additional information, refer to Chapter 5, "Troubleshooting."

CHAPTER 5: TROUBLESHOOTING

This chapter provides information about troubleshooting the Model FS518T Fast Ethernet Switch. Table 5-1 lists symptoms, causes, and solutions of possible problems.

Table 5-1. Troubleshooting Information

Symptom	Cause	Solution
Power LED is off.	No power is received at the hub.	Check the power cord connections for the switch and the connected device. Check for a defective adapter card, cable, or port by testing them in an alternate environment where all products are functioning. Make sure all cables used are correct and comply with Ethernet specifications.
Either 10M, 100M, or 1000M Link LED is off or intermittent.	Port connection is not functioning.	Check the crimp on the RJ-45 connectors, and make sure that the plug is properly inserted and locked into the port at both the switch and the connecting device. Make sure all cables used are correct and comply with Ethernet specifications.
One or more components are malfunctioning.	Not all system components are properly installed.	Test the components in an alternate environment where all other components are functioning properly.
A segment or device is not recognized as part of the network.	One or more devices are not properly connected or cabling does not meet Ethernet guidelines.	Verify that the cabling is correct (refer to Appendix C, "Cabling Guidelines"). Be sure all cable connectors are securely positioned in the required ports. Straight-through cables should be used for all standard twisted pair connections. Make sure all devices are connected to the network. Equipment may have been accidentally disconnected.

Network Adapter Cards

Make sure the network adapter cards installed in the PCs are in working condition and the software driver has been installed.

Configuration

If problems occur after altering the network configuration, restore the original connections and determine the problem by implementing the new changes, one procedure at a time. Make sure that cable distances, repeater limits, and other physical aspects of the installation do not exceed the Ethernet limitations.

Switch Integrity

If required, verify the integrity of the switch by resetting the switch. Turn power to the switch off and then back on. If the problem continues and you have completed all the preceding diagnoses, contact your NETGEAR point-of-sale representative.

Auto Negotiation

The 10/100 Mbps ports will negotiate the correct duplex mode and speed, provided the link partner supports auto negotiation. If the link partner does not support auto negotiation, only the speed will be determined correctly and the duplex mode will default to half.

The Gigabit ports will negotiate speed, duplex mode and flow control, provided that the link partner supports the auto-negotiation mechanism.

APPENDIX A: TECHNICAL SPECIFICATIONS

This appendix provides technical specifications for the Model FS518T Fast Ethernet Switch.

General Specifications

Network Protocol and Standards Compatibility

ISO/IEC 802-3i 10BASE-T

IEEE 802.3u 100BASE-TX

IEEE 802.3ab 1000BASE-T

IEEE 802.3x flow control

Data Rate

10 Mbps differential Manchester encoded, IEEE 802.3

100 Mbps with 4B/5B encoding and MLT-3 physical interface for 100BASE-TX

1000 Mbps with 8B/10B encoding PAM-5 physical interface for 1000BASE-T

Interface

RJ-45 connector for 10BASE-T, 100BASE-TX Fast Ethernet and 1000BASE-T Gigabit Ethernet

Electrical Specifications

Power consumption: 45 W maximum

Physical Specifications

Dimensions:	(W) 13 by (H) 1.7 by (D) 8 in. (W) 33.0 by (H) 4.3 by (D) 20.3 cm
Weight:	5.0 lb 2.3 kg

Environmental Specifications

Operating temperature:	0 to 40°C
Storage temperature:	-32 to 104°C
Operating humidity:	90% maximum relative humidity, noncondensing
Storage humidity:	95% maximum relative humidity, noncondensing
Operating altitude:	10,000 ft (3,000 m) maximum
Storage altitude:	10,000 ft (3,000 m) maximum

Electromagnetic Emissions

Meets requirements of:	CE mark, commercial
	FCC Part 15, Subpart B, Class A
	EN 55 022 (CISPR 22), Class A
	VCCI Class 1A

Electromagnetic Susceptibility

CE mark, commercial

Electrostatic discharge (ESD):	IEC 801-2, Level 2/3
Radiated electromagnetic field:	IEC 801-3, Level 2
Electrical fast transient/burst:	IEC 801-4, Level 2
Electrical surge:	IEC 801-5, Level 1/2

Safety Agency Approvals

CE mark, commercial

UL listed (UL 1950)

CSA certified (CSA 22.2 #950)

TUV licensed (EN 60 950)

Performance Specifications

Frame filter rate:	14,800 frames/second, maximum on 10 Mbps port 148,000 frames/second, maximum on 100 Mbps port 1,480,000 frames/second, maximum on 1000 Mbps port
Frame forward rate:	14,800 frames/second, maximum on 10 Mbps port 148,000 frames/second, maximum on 100 Mbps port 1,480,000 frames/second, maximum on 1000 Mbps port
10/100 buffer memory:	8 MB for 16 ports 4 MB for 2 ports
Gigabit buffer memory:	2 MB
Forwarding modes:	Store-and-forward
Network latency:	Less than 80 microseconds for 64-byte frames in store-and-forward mode for 10 Mbps to 100 Mbps transmission
Address database size:	8,000 media access control (MAC) addresses per system
Addressing:	48-bit MAC address

APPENDIX B: CONNECTOR PIN ASSIGNMENTS

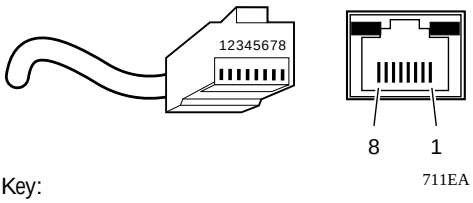
This appendix provides information about the RJ-45 plug and the RJ-45 connector used for the NETGEAR Model FS518T Fast Ethernet Switch with Gigabit uplinks.

RJ-45 Plug and Vista RJ-45 Connector

In a Fast Ethernet network, it is important that all 100BASE-T certified Category 5 cabling use RJ-45 plugs. The RJ-45 plug accepts 4-pair UTP or shielded twisted pair (STP) 100 ohm cable and connects into the vista RJ-45 connector.

The vista RJ-45 connector is used to connect stations, hubs, and switches through UTP cable; it supports 10 Mbps, 100 Mbps, or 1000 Mbps data transmission.

The RJ-45 plug and vista RJ-45 connector are both illustrated in Figure B-1.



Key:
1 to 8 = pin numbers

Figure B-1. RJ-45 Plug and Vista RJ-45 Connector with Built-in LEDs

Table B-1 lists the pin assignments for the 10/100 Mbps RJ-45 plug and the vista RJ-45 connector.

Table B-1. 10/100 Mbps RJ-45 Plug and Vista RJ-45 Connector Pin Assignments

Pin	Normal Assignment on Ports 1 to 8	Uplink Assignment on Port 8
1	Input Receive Data +	Output Transmit Data +
2	Input Receive Data –	Output Transmit Data –
3	Output Transmit Data +	Input Receive Data +
6	Output Transmit Data –	Input Receive Data –
4, 5, 7, 8	Internal termination, not used for data transmission	

Table B-2 lists the pin assignments for the 100/1000 Mbps RJ-45 plug and the vista RJ-45 connector.

Table B-2. 100/1000 Mbps RJ-45 Plug and Vista RJ-45 Connector Pin Assignments

Pin	Channel	Description
1 2	A	Rx/Tx Data + Rx/Tx Data -
3 6	B	Rx/Tx Data + Rx/Tx Data -
4 5	C	Rx/Tx Data + Rx/Tx Data -
7 8	D	Rx/Tx Data + Rx/Tx Data -

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APPENDIX C: CABLING GUIDELINES

This appendix provides specifications for cables used with the Model FS518T Fast Ethernet Switch.

Fast Ethernet Cable Guidelines

Fast Ethernet uses UTP cable, as specified in the IEEE 802.3u standard for 100BASE-TX. The specification requires Category 5 UTP cable consisting of either two-pair or four-pair twisted insulated copper conductors bound in a single plastic sheath. Category 5 cable is certified up to 100 MHz bandwidth. 100BASE-TX operation uses one pair of wires for transmission and the other pair for receiving and for collision detection.

When installing Category 5 UTP cabling, use the following guidelines to ensure that your cables perform to the following specifications:

- Certification

  Make sure that your Category 5 UTP cable has completed the Underwriters Laboratories (UL) or Electronic Testing Laboratories (ETL) certification process.

- Termination method

  To minimize cross-talk noise, maintain the twist ratio of the cable up to the point of termination; untwist at any RJ-45 plug or patch panel should not exceed 0.5 inch (1.5 cm).

Category 5 Cable

Category 5 distributed cable that meets ANSI/EIA/TIA-568-A building wiring standards can be a maximum of 328 feet (ft) or 100 meters (m) in length, divided as follows:

- 20 ft (6 m) between the hub and the patch panel (if used)
- 295 ft (90 m) from the wiring closet to the wall outlet
- 10 ft (3 m) from the wall outlet to the desktop device

The patch panel and other connecting hardware must meet the requirements for 100 Mbps operation (Category 5). Only 0.5 inch (1.5 cm) of untwist in the wire pair is allowed at any termination point.

Category 5 Cable Specifications

Ensure that the fiber cable is crossed over to guarantee link.

Table C-1 lists the electrical requirements of Category 5 UTP cable.

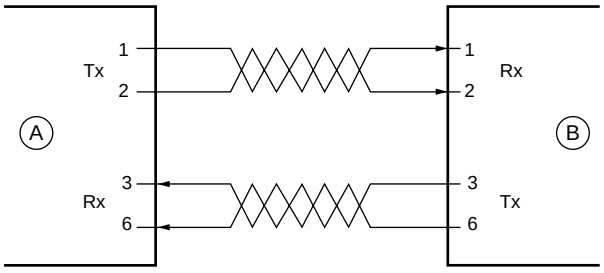
Table C-1. Electrical Requirements of Category 5 Cable

Specification	Category 5 Cable Requirements
Number of pairs	Four
Impedance	100 Ω ± 15%
Mutual capacitance at 1 KHz	≤ 5.6 nF per 100 m
Maximum attenuation (dB per 100 m, at 20° C)	at 4 MHz: 8.2 at 31 MHz: 11.7 at 100 MHz: 22.0
NEXT loss (dB minimum)	at 16 MHz: 44 at 31 MHz: 39 at 100 MHz: 32

Twisted Pair Cables

For two devices to communicate, the transmitter of each device must be connected to the receiver of the other device. The crossover function is usually implemented internally as part of the circuitry in the device. Computers and workstation adapter cards are usually media-dependent interface ports, called MDI or uplink ports. Most repeaters and switch ports are configured as media-dependent interfaces with built-in crossover ports, called MDI-X or normal ports.

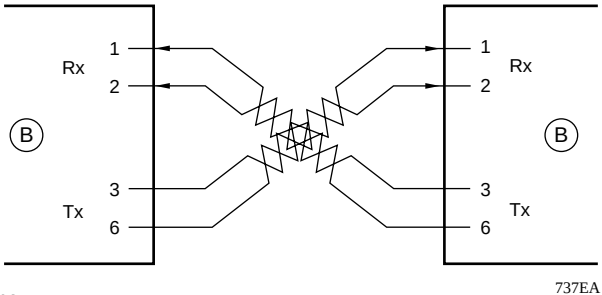
Figure C-1 illustrates straight-through twisted pair cable.



Key:
A = Uplink or MDI port (as on a PC)
B = Normal or MDI-X port (as on a hub or switch)
1, 2, 3, 6 = Pin numbers

Figure C-1. Straight-Through Twisted Pair Cable

Figure C-2 illustrates crossover twisted pair cable.



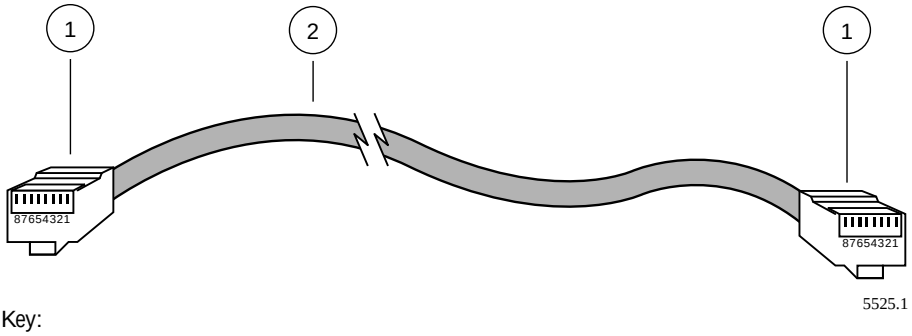
Key:
B = Normal or MDI-X port (as on a hub or switch)
1, 2, 3, 6 = Pin numbers

Figure C-2. Crossover Twisted Pair Cable

Patch Panels and Cables

If you are using patch panels, make sure that they meet the 100BASE-TX requirements. NETGEAR recommends Category 5 UTP cable for all patch cables and work area cables to ensure that your UTP patch cable rating meets or exceeds the distribution cable rating.

To wire patch panels, you need two Category 5 UTP cables with an RJ-45 plug at each end, as shown in Figure C-3.



Key:
1 = RJ-45 plug
2 = Category 5 UTP patch cable

Figure C-3. Category 5 UTP Patch Cable with Male RJ-45 Plug at Each End

Note: Flat "silver satin" telephone cable may have the same RJ-45 plug. However, using telephone cable will result in excessive collisions and cause the attached port to be partitioned or disconnected from the network.

Using 1000BASE-T Gigabit Ethernet over Category 5 Cable

Overview

When using the new 1000BASE-T standard, the limitations of cable installations and the steps necessary to ensure optimum performance must be considered. The most important components in your cabling system are patch panel connections, twists of the pairs at connector transition points, the jacket around the twisted pair cable, bundling of multiple pairs on horizontal runs and punch down blocks. All of these will affect the performance of 1000BASE-T technology if not correctly implemented. The following sections are designed to act as a guide to correct cabling for 1000BASE-T.

Cabling

The 1000BASE-T product is designed to operate over Category 5 cabling, but to further enhance the operation, the cabling standards have been amended. The latest standard is Category 5e, which defines a higher level of link performance than is available with Category 5 cable.

If installing new cable, we recommend using Category 5e cable, since it costs the same as Category 5 cable. If using the existing cable, be sure to have the cable plant tested by a professional who can verify that it meets or exceeds either ANSI/EIA/TIA-568-A:1995 or ISO/IEC 11801:1995 Category 5 specifications.

Length

The maximum distance limitation between two pieces of equipment is 100 m, as per the original Ethernet specification. The end to end link is called the "channel." TSB-67 defines the "Basic Link" which is the portion of the link that is part of the building infrastructure. This excludes patch and equipment cords. The maximum basic link length is 295 feet (90 m).

Return Loss

Return loss measures the amount of reflected signal energy resulting from impedance changes in the cabling link. The nature of 1000BASE-T renders this measurement very important; if too much energy is reflected back on to the receiver, the device will not perform optimally.

All four pairs of the twisted pair are used by 1000BASE-T, unlike 10BASE-T and 100BASE-TX, which use only two of the four pairs of wires within the Category 5. It is important to ensure that all wires are tested.

The factors that will affect the return loss are

- the number of transition points, as there is a connection via an RJ-45 to another connector, a patch panel, or a piece of equipment at each transition point.
- removal of the jacket that surrounds the four pairs of twisted cable. It is highly recommended that, where RJ-45 connections are made, this is minimized to 1-1/4 inch (32 mm).
- pair untwist of any of the twisted pairs. It is important that this be minimized to 3/8 inch (10 mm) where RJ-45 connections are made.
- cabling or bundling of multiple Category 5 cable. This is regulated by ANSI/EIA/TIA-568A-3, and can adversely affect all parameters of the cabling if not correctly implemented.

Near End Cross Talk (NEXT)

This is a measure of the signal coupling from one wire to another, within a cable assembly, or among cables within a bundle. NEXT measures the amount of cross-talk disturbance energy that is detected at the near end of the link—the end at which the transmitter is located. NEXT measures the amount of energy that is "returned" to the sender end. The factors that affect NEXT and cross talk are exactly the same as outlined in the Return Loss section. The cross-talk performance is directly related to the quality of the cable installation.

Patch Cables

When installing your equipment, replace old patch panel cables that do not meet Category 5e specifications. As pointed out in the NEXT section, this near end piece of cable is critical for successful operation.

Conclusions

For optimum performance of your 1000BASE-T product, it is important to fully qualify your cable installation and ensure it meets or exceeds ANSI/EIA/TIA-568-A:1995 or ISO/IEC 11801:1995 Category 5 specifications. Install Category 5e cable where possible, including patch panel cables. Minimize transition points, jacket removal, and untwist lengths. Bundling of cables must be properly installed in order to meet the requirements in ANSI/EIA/TIA-568A-3.

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NETGEAR™

NETGEAR, Inc.
4401 Great America Parkway
Santa Clara, CA 95054 USA
Phone: 1-888-NETGEAR
www.NETGEAR.com

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